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ABSTRACT

This report is one in a series written on the Resource Requirements Prediction Model (RRPM-1) developed by the National Center for Higher Education Management Systems (NCHEMS). This particular document traces briefly the development of RRPM, its design objectives, testing and implementation at pilot institutions, and the resources required for implementation of the model. It also lists some evaluations by the pilot institutions. This report is addressed to higher education administrators, specifically the top administrator who must make a decision whether or not to implement RRPM. (Author/HS)

A RESOURCE REQUIREMENTS PREDICTION MODEL (RRPM-1): AN INTRODUCTION TO THE MODEL

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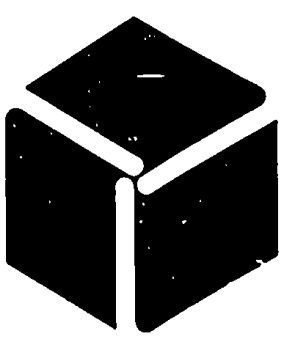
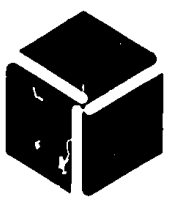
Technical Report 19

National Center for Higher Education Management Systems at WICHE





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NATIONAL CENTER FOR HIGHER EDUCATION MANAGEMENT

SYSTEMS AT WICHE

A RESOURCE REQUIREMENTS PREDICTION MODEL (RRPM-1): --AN INTRODUCTION TO THE MODEL

NCHEMS Technical Report 19

by

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Systems at WICHE

P. O. Drawer P, Boulder, Colorado

80302

October 1971

CONTENTS

LIST OF FIGURES

ACKNOWLEDGEMENTS

The RRPM system has been developed as a result of the contributions of numerous individuals and institutions. We are particularly grateful to the original design group (see Appendix C) and the RRPM-1 Task Force (see Appendix D) for their many fine contributions to the project. The initial design of RRPM-1 was developed by Mathematica of Princeton, New Jersey, under the direction of Dr. Norman I. Agin and Mr. Roger L. Sisson. We are indebted to Dr. George B. Weathersby for his work in the original conceptualization and subsequent efforts in the development of RRPM-1.

The prototype system (Version 1.2) developed for the pilot test and the release version of RRPM (Version 1.3) were designed and programmed by Mr. James S. Martin of our staff. The revised Report Module was designed and programmed by Mr. Charles R. Thomas, Program Assoicate for Information Systems. The RRPM-1.3 Preprocessor and the RRPM-1.3 Tracer/Trainer were designed and programmed by Dr. Pasha Hussain and members of his staff at New Mexico State University.

We acknowledge gratefully the substantive participation by the eight pilot test institutions. The accomplishments of this project is due in large part to their willingness to underwrite a significant portion of the developmental costs and to members of their staff who gave willingly their time to this effort.

PREFACE

RRPM-1 Documentation

This publication is part of the documentation for the initial NCHEMS Resource Requirements Prediction Model, RRPM-1. The total documentation package consists of a number of publications, a set of computer programs, and a set of visuals to support training. These materials are available individually or in sets. Three sets of documentation have been developed for various purposes.

A. One set of documents is addressed to administrators and/or managers of higher education institutions. It consists of three documents that describe the structure of the model and its use in an institution of higher education:

NCHEMS Technical Report 19, A Resource Requirements Prediction Model (RRPM-1): An Introduction to the Model

NCHEMS Technical Report 20, A Resource Requirements Prediction Model (RRPM-1): Guide for the Project Manager

NCHEMS Technical Report 21, A Resource Requirements Prediction Model (RRPM-1): Report on the Pilot Studies

The Introduction is addressed to higher education administrators, specifically the top administrator who must make a decision whether or not to implement RRPM. It traces briefly the development of RRPM, its design objectives, testing and implementation at pilot institutions, and the resources required for implementation. It also lists some evaluations by the pilot institutions. The Introduction is based in part on the initial description of the model published in January 1971, The Resource Requirements Prediction Model 1 (RRPM-1): An Overview. The material in this document is now contained in the Introduction and in the Guide. The Guide provides information on the structure of the model and the data required by the model to simulate the institution. In addition, the Guide discusses the process of implementation with special attention to modifying the model, testing it, and training personnel in understanding and using the model. Also included in the Guide is an extensive annotated bibliography of literature related to planning in higher education.

B. The second set of documentation is technical information of interest to the systems analyst and the programmer. This documentation set consists of:

NCHEMS Technical Report 22, A Resource Requirements Prediction Model (RRPM-1): Programmer's Manual

NCHEMS Technical Report 23, A Resource Requirements Prediction Model (RRPM-1): Input Specifications

RRPM-1 Input-Output Package

Computer Programs for RRPM System

The Programmer's Manual discusses the details of the RRPM-1 computer programs. It also contains an algebraic representation of RRPM-1 that will be useful in understanding the analytical details of the model. The inputs required for RRPM are described in the Input Specifications. Included are blank input forms for manual data input. Samples of input forms completed for a hypothetical institution and the output reports generated from the sample input data are contained in the Input-Output package. This will facilitate the testing of the programs using the test data set provided on tape.

C. The third set in the documentation package for RRPM-1 contains materials to aid in training on the model. At the present time this package contains:

Resource Requirements Prediction Model (RRPM-1) Technical Workshop Notes

RRPM-1 Visual Aids

The Notes are hard copy reproductions of the visual aids used at the RRPM-1 Technical Workshop conducted by NCHEMS. The RRPM-1 Visual Aids are duplicates of the visuals used in the RRPM-1 Technical Workshop. These materials are made available to encourage institutions to undertake training of their personnel in the use of the model. Additional materials may be added at a later date.

The RRPM system was developed under a USOE Contract No. OEC-0-8-980708-4533(010). The development cost was supplemented in part by the pilot institutions that gave much of their time and resources to testing and implementing the model. The results of this cooperative effort are available to all interested parties at a nominal cost to cover reproduction and distribution. Further details regarding the RRPM project can be obtained by writing to:

Mr. James S. Martin
RRPM Project Manager
National Center for Higher Education
Management Systems at WICHE
P. O. Drawer P
Boulder, Colorado 80302

The following table attempts to aid the reader by identifying the relevant areas of the documentation package. The table is based on different levels of interest in the materials relative to the reader's role in implementating and using the RRPM-1 system. The coding in the table refers to the chapter or section in the Technical Reports; e.g. TR 19-5 refers to NCHEMS Technical Report 19, A Resource Requirements Prediction (RRPM-1): An Introduction to the Model, Section 5.

	ADMINISTRATOR/ EXECUTIVE USER	PROJECT MANAGER	ANALYST/ PROGRAMMER
IMPLEMENTATION	TR19-7	TR19-7 TR20-2,8	TR22-5
MODEL USES	TR19-5	TR20-7	TR22-3
PILOT TEST	TR19-4,6 TR21	TR19-4 TR21	TR21
STRUCTURE	TR19-5 TR20-4	TR20-4 TR22-2	TR20-4 TR22-2
OUTPUTS	TR19-A,B	TR19-A,B TR20-7 TR22-4	TR22-4
INPUTS	--------	TR20-5 TR23	TR22-1 TR23
HARDWARE	--------	TR20-3 TR21-1 TR22-2,4	TR22-2,4,5

A RESOURCE REQUIREMENTS PREDICTION MODEL (RRPM-1):

AN INTRODUCTION TO THE MODEL

1. Introduction

This paper is addressed to the administrator (manager) in higher education who must decide whether or not his institution should implement the initial NCHEMS Resource Requirements Prediction Model (RRPM-1). The paper does not cover the technical details of programming nor the considerations of interest to a "project manager" who is charged with the responsibility to implement RRPM-1. These subjects are covered elsewhere.[1] What is covered here is a discussion of the environment or setting for using an analytical technique such as RRPM-1, the model's basic design criteria and structure, its pilot testing, and its evaluation. This is followed by a discussion of the resources required for implementing RRPM-1, the steps required to ensure its successful implementation, and finally, a brief discussion of related techniques that are under development.

2. Background

The increasing student demand for higher education, combined with rising operating costs, has intensified the need for planning in both public and private institutions. The imbalance that often exists between decision requirements and available information is becoming evident as educational resources grown increasingly scarce and the demand for services (both educational and other societal services) expands. In order to provide information that will aid in making decisions regarding long-range planning, it is apparent that the analytical tools for management science must play a larger role in the management of American colleges and universities.

One such tool is a simulation model. For our purposes, "simulation is the action of performing experiments on a model of a given system...(and a) model is a representation of the system."[2] Although a number of sophisticated cost simulation models for higher education have been developed and operated using experimental data for testing and research purposes, these models have not been widely implemented at operational levels in institutions of higher education for several practical reasons:

1. Existing demands on the institutional staff and the lack of sufficient resources for internal management applications prevent any serious attempt at such implementation.

2. Simulation models in higher education are not sufficiently proven at this time to warrant a level of confidence sufficient to persuade administrators to change their current methods of budgeting and planning.

3. The high costs of implementation are such that many institutions question the value of implementing an uproven model. They prefer to wait for results from other institutions before launching into their own program.

For these and other reasons, the use of simulation models in higher education is not widely accepted. Moreover, model development has been inhibited because of the large investments required. Development of a simulation model (particularly large scale simulation models) by a single institution is a difficult and costly task. In an effort to overcome these problems, the participating institutions of the National Center for Higher Education Management Systems (NCHEMS) at WICHE requested the staff to undertake the development of analytical models that can aid the higher education decision maker in evaluating current operations and in analyzing future resource allocations. The result is the initial version of a Resource Requirements Prediction Model, referred to as RRPM-1. It is an institution-oriented, computer-based simulation model that projects the cost of operating a college campus over a ten year time frame. RRPM-1 may be viewed as a management tool that will assist higher education decision makers in understanding the future implications of planning decisions.

3. Design Criteria

During the summer of 1969, the staff at NCHEMS along with an advisory design group (see Appendix C) reviewed a number of cost simulation models that had been designed for use in institutions of higher education.[3] Based on this review, design guidelines were specified for the initial version of the Resource Requirements Prediction Model, RRPM-1. These guidelines suggested that the concept for the model be relatively straightforward in order that it might be understood easily by executive level administrators in higher education and that it be designed to assist decision making for long-range planning at the campus level. RRPM-1 will not produce an extremely detailed analysis (such as specific course data) because it is designed to have manageable data requirements and have the capability to operate on a medium-scale computer system. RRPM-1 is concerned primarily with simulating the cost of instruction programs in higher education, later versions will deal with disaggregated data and detailed simulation of the research and public service functions. The model has been developed in a modular fashion (i.e., consisting of discrete units) in order to facilitate modification and the

incorporation of improvements. In accordance with the design guidelines, a prototype model was developed by Mathematica based upon C. B. Weathersby's conceptualization as utilized in the Cost Simulation Model[4] implemented at the University of California. The prototype model (RRPM-1.1) was subsequently redesigned by the NCHEMS staff and the RRPM-1 Task Force. The model, RRPM-1.2, was subjected to an extensive test and evaluation. The various individuals participating in the development and test of RRPM-1.2 are listed in Appendix D.

4. Pilot Studies

Eight pilot institutions were selected to test and implement RRPM-1. These schools and the computer used are listed in Figure 1. One representative from each of these eight institutions, in addition to one representative from each of three other institutions (University of Illinois, University of Colorado and State Central Junior College District at Fresno, California), constituted the RRPM-1 Task Force responsible for developing the model and incorporating the results of the testing by the pilot institutions.

FIGURE 1

RRPM-I PILOT TEST

PARTICIPATING INSTITUTIONS

1. HUMBOLDT STATE COLLEGE (CDC 3300)
2. NEW MEXICO JUNIOR COLLEGE (IBM 360/50: NMSU)
3. PORTLAND STATE UNIVERSITY (IBM 360/50: U of Oregon)
4. STANFORD UNIVERSITY (IBM 360/40, 256K)
5. STATE UNIVERSITY OF NEW YORK AT STONY BROOK (IBM 360/67)
6. UNIVERSITY OF CALIFORNIA, LOS ANGELES (IBM 360/91)
7. UNIVERSITY OF UTAH (UNIVAC 1108)
8. WASHINGTON STATE UNIVERSITY (IBM 360/67)

Each of the eight pilot institutions implemented RRPM-1.2 and tested its validity. One institution tested the model using historical data for three years. For each year, the model predicted the total resources required within 5% of the actual value for each discipline and within 10% of the actual value for each departmental level. At other schools the error ranged from small (5%) to very large (over 20%) deviations from actual values. It is expected that the accuracy of the model will improve as the data base

improves and as one predicts the budget for administrative units (departments) instead of for discipline levels as was done in the pilot studies. However, substantial errors may occur in cases where the structure of RRPM-1 does not relate to the reality of the institution.

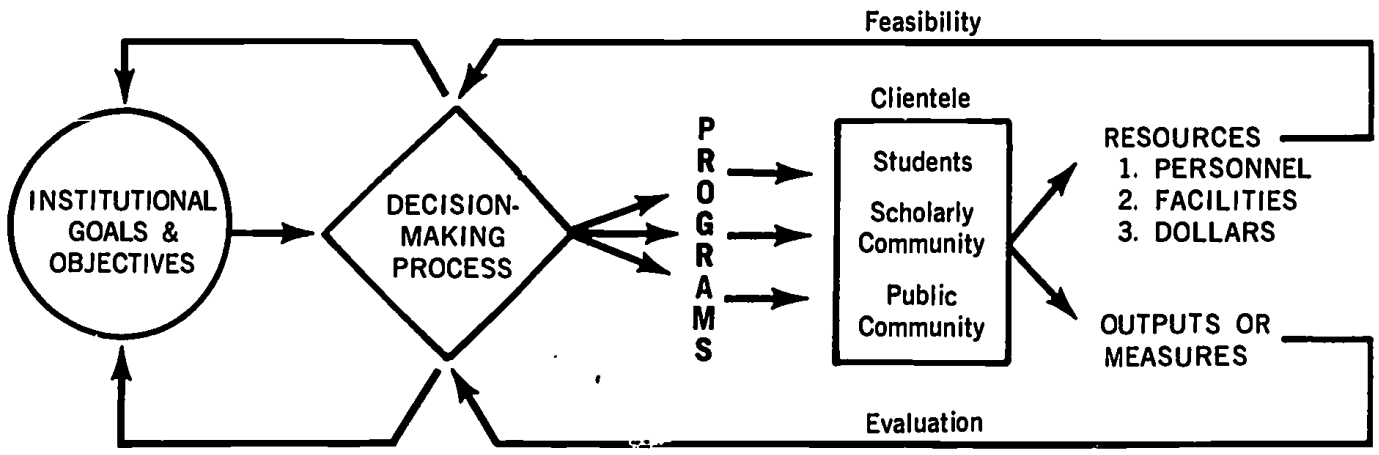
The RRPM-1 pilot study indicated that the model may be operated in either of two modes: (1) as a prediction model, or (2) as an experimental device to examine and compare a number of planning alternatives. In the prediction mode, accuracy is important and, as previously stated, is highly dependent on the parameters and coefficients used for prediction as well as the stability of the organization and its environment. In the experimental mode, the precision of the estimate is not a major concern since relative changes are of interest rather than absolute amounts.

The capability to calculate resources for any administrative unit as well as many other features considered necessary as a result of the pilot experiences were incorporated in a third version of the model, known as RRPM-1.3. This is the released version. Earlier versions of RRPM are prototype designs and have not been released. The basic structure of RRPM-1.3 (referred to henceforth as RRPM-1) and its role in decision making are described in the sections following.

5. The Structure and Role of RRPM-1

The RRPM system is a long-range planning model designed to aid higher level management in rapidly determining the resource implications of alternative policy and planning changes. Figure 2 provides one way of viewing the planning cycle in higher education. This particular representation characterizes the planning cycle as a closed loop. The determination of where an institution starts or initiates the planning cycle depends in large part upon the nature of the institution.

FIGURE 2
A REPRESENTATION OF THE PLANNING CYCLE



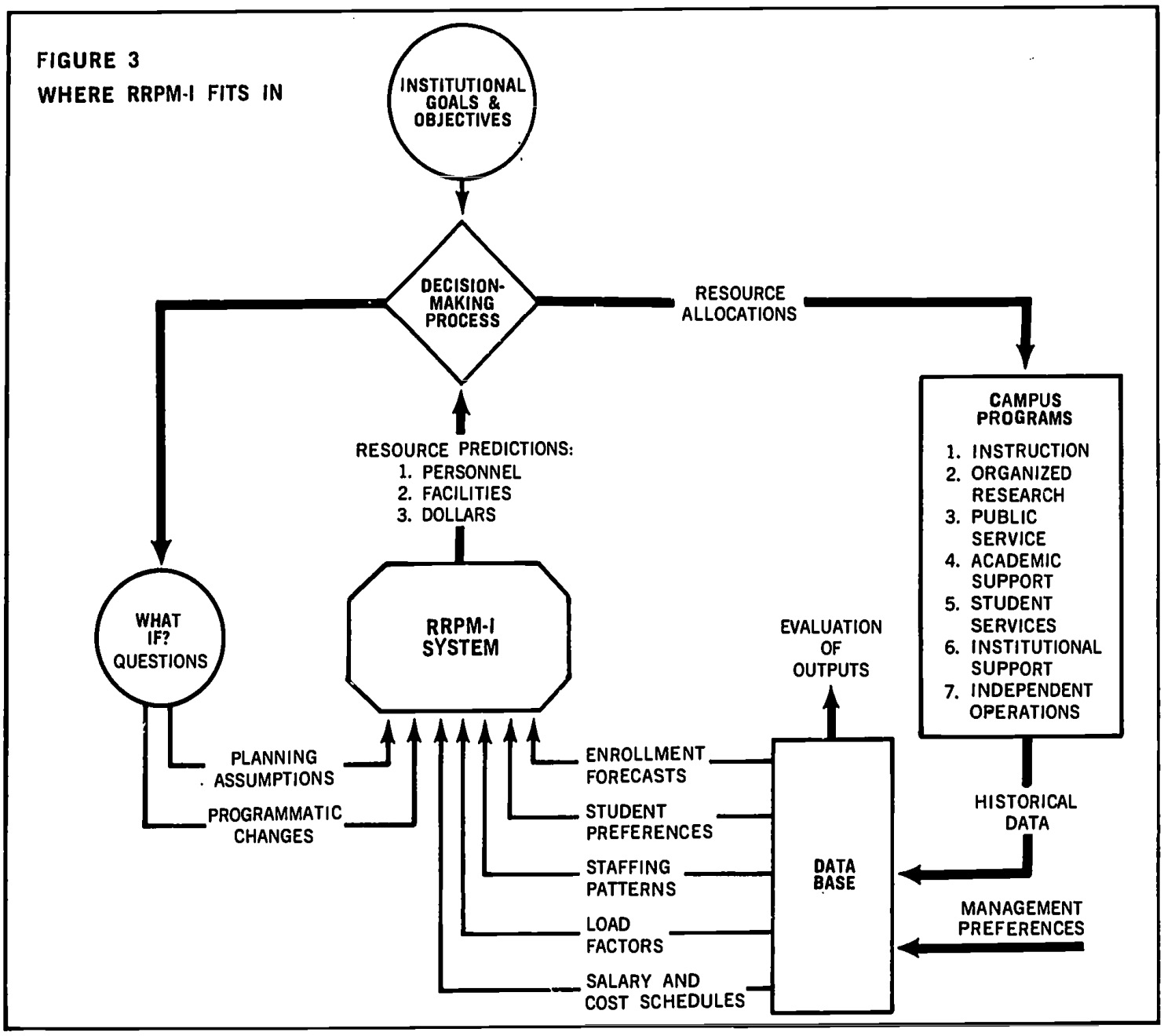
In general, higher education programs are devised to serve the clientele of the institution: the students through instructional programs, the scholarly community through research programs, and the public community through public service programs. Associated with each set of program activities are the resources required to establish and operate the program, and the outputs or measures of contribution to the objectives of the program. Higher education operates with scarce resources, and therefore, the outputs of each program must be evaluated with regard to the resource requirements in terms of the feasibility of providing the resources. This requires the ability to make trade-offs between both the number of programs and their scale of operation. In some cases, the trade-off decisions may require a re-evaluation of the institution's goals and objectives.

In a planning sense, this process is iterated until a set of programs is designed that collectively provides the maximum benefits (in terms of the goals and objectives of the institution) within the set of resources available. Given this particular view of the planning cycle, the RRPM system provides a mathematical conversion of program activity to resource requirements. The RRPM is designed to aid decision making by providing quantitative estimates of the total set of resource requirements for the institution. It provides a computational tool that enables the decision maker to examine a greater number of planning alternatives.

A more detailed view of where RRPM-1 fits in the planning and decision-making process is described in Figure 3. The institutional decision-making process determines the resource allocation to campus programs based on the institutional goals and objectives. The operations of each program provide historical data regarding the scale of activity and resource requirements of the various programs. These historical data are contained in the institution's data base along with data reflecting management preferences. The RRPM-1 system draws various sets of information from the data base, including enrollment forecasts, information on student course preferences, staff and facility loading factors, salary and various other cost schedules as inputs to the system.

The decision makers, in attempting to balance the institution's programs against the resources available, ask a number of "what if" questions. The "what if" questions are reflected in terms of changes to the planning assumptions, programs offered and parameters as shown in Figure 3. The term "parameter" refers to variables in the model that define the characteristics or attributes of the institution and remain constant for a given simulation. Examples are: average section size, faculty load, number of departments, staffing ratio, ect. The RRPM-1 system uses the parameter data to compute resource predictions in terms of personnel, facilities, and support dollars as an aid to the decision-making process. A comparative set of results of up to ten cases are printed on one report. These ten cases can be for any one year or a number of cases each for a number of years but no more than ten cases on one report. An example of such a report is shown in Appendix B.

FIGURE 3
WHERE RRPM-I FITS IN



The "what if" mode enables the manager to experiment on paper with a variety of changes. Examples of the type of "what if" questions can be classified into four categories:

A. Staffing Changes

...What if the current staffing ratio of support personnel was increased or decreased by 10%?

...What if the average faculty load in a given college was increased to the average of other colleges?

...What if there was an X% raise in faculty salaries and a Y% raise in nonfaculty salaries?

...What if a change is made in the mix of instructional faculty? (Such changes might be in the ratio of full to assistant professors or the use of graduate assistants in recitations instead of assistant professors.)

...What if a change is made in instructional techniques? --e.g., substitute capital (equipment) for labor (faculty).

B. Curriculum Changes (Note: A curriculum change typically requires extensive modifications to other curricula).

...What if a new degree program was to be added and another were to be dropped?

...What if a service discipline (not offering a degree program) was added?

...What would be the effect on the math service courses if the junior college transfer sector was to increase by 60%?

...What would be the effect on the English department if the English Composition requirements for math majors were removed?

C. Admissions Policy

...What if a specific change is made in the mix of students either by degree program or by level or both?

...What if the institution limits its admission in various fields three years from now?

...What if the enrollment for a given level of students was eliminated or initiated?

D. Other

...What if there were additions or deletions to existing programs in Research and Public Service?

...What if one or more of the factors in space or construction were to change?

...What if the cost relationships for travel, equipment and supply were to be altered?

...What if the library costs per student were increased by 10%?

The resource implications of questions such as the above and others may be answered in an aggregate manner through the use of the RRPM-1. Clearly, there are other subjective implications which reflect upon the quality of operations such as effects on students, contributions to society, and impact

on faculty values. The state-of-the-art in modeling has not advanced sufficiently to deal in a quantitative manner with this aspect of planning and programmatic changes. However, the ability to compute rapidly the resource implications of alternatives will lead, hopefully, to a more ordered and structured consideration of the subjective aspects of higher education.

Input requirements for RRPM-1 are structured to be compatible with the WICHE Data Element Dictionary[5] and the Program Classification Structure.[6] The output is also compatible with the Program Classification Structure (PCS). The output for instruction is a set of five reports by department or discipline:

A. Personnel by FTE and salary costs for each of 5 faculty ranks and 4 non-academic ranks, including supply, travel, and equipment expense.

B. Student load by 4 course levels and 4 types of instruction.

C. Faculty load by 4 course levels and 4 types of instruction.

D. Space requirements for 5 types of instruction facilities including office space.

E. Cost per credit hour by level of course and cost per student by level of student.

In addition, a report showing student data and costs by field of study (major) and student level is available. Each of the above reports, with the exception of the cost per credit hour and cost per student reports, can be aggregated at any level that is designated by the user. As an illustration, the levels of aggregation could be:

A. Discipline
B. Department
C. Division
D. School/College
E. Campus

These reports can be generated for each PCS instruction subprogram: general academic, occupational and vocational, special session and extension. The title of each report and the level of aggregation are defined by the user and can be made to correspond with the organizational structure of the institution.

There are two other reports on instruction that are generated for the entire campus. These are:

A. Total construction costs required by space type.
B. Total enrollment aggregated to 4 student levels.

For the noninstructional programs there are two types of reports:

A. FTE and costs for academic and nonacademic personnel including supply, equipment, and travel expense.

B. Space requirements for 17 types of noninstructional facilities plus office space.

These reports can be generated for all the subprograms within the Program Classification Structure. A sample of each of the above types of reports is shown in Appendix A.

Whether the output be an answer to a "what if" question or whether it be a standard output, the RRPM-1 is merely an aid to the manager. It provides the manager with relevant and timely information. It does not replace the manager's judgment or prerogative. The manager still identifies the assumptions, programs, and parameters; studies the consequences generated by RRPM-1, and then makes his choice.

6. Evaluation of RRPM-1

One way to evaluate RRPM-1 is to study the evaluations of the pilot institutions that implemented RRPM-1. Some extracts[7] appear below.

"RRPM locates inaccuracies in information and forces us to ask how can we correct our input (and upgrade the informations system and data base)...RRPM does not show impact on the organization (people, program, structure, etc.)--particularly the qualitative aspects... It is not a budget generator;...it is not a decision generator.

...a great danger of misinterpretation arises in regard to the meaning of the particular outputs of the model. The guard against this is a thorough working knowledge of RRPM and the assumptions that underlie it. This knowledge will come only with experience gained by working closely with the model over a period of time.

RRPM has great potential as a planning tool that can improve resource management in higher education. Its cost computations represent an important first step in the difficult task of allocating educational costs back to degree winners, the ultimate product of the educational process.

RRPM has its greatest potential as a campus planning tool. In fact, one of the greatest benefits that may come from the model is a medium for improving communication among all levels of the decision-making process.

Used in a predictive mode, RRPM generates a large amount of information relevant to the planning of both support and capital budgets. Used in a simulation or experimental mode it provides a powerful research tool for examining alternative policy formulations.

At this stage, we view the primary potential of RRPM as motivating a learning process concerned with the cause and effect relationships that generate and describe an institution's resource requirements.

One of the advantages of models of the RRPM type is the increased knowledge and insight gained by decision makers concerning their institution, its structure, process, environment, etc."

D. Lawson, Director of Institutional Studies
Humboldt State College

"...at least at first, the model will be a most valuable tool for pinpointing unsuspected effects of program or enrollment changes and for indicating where these effects show up and how wide ranging they are.

If indeed one learns from the past in attempting to predict the future, then the exercise of creating an internally consistent and satisfactorily complete data base will be a valuable learning experience. It is like a comprehensive and highly organized course in the recent history of the institution. Those of us involved in RRPM at our university have just completed the course; it was an informative one.

...We are going to have these systems...because they are being demanded of us--indeed they already are--by those who make available the funds required of higher education. We do not, in fact, have a choice. It is a case of joining the new management technology or having it thrust upon us."

R. J. Low, Vice President for Administration
Portland State University

"With the experience of testing and implementing the RRPM-1 I have become most interested in the potential of this program in answering "What if" questions. Our experience with the RRPM-1 has given us an appreciation of the many variables and their interactions and options in the management of this institution. The program has also provided us with a strong data base for future institutional analysis and research."

J. Smith, President
New Mexico Junior College

"RRPM ignores the interaction of some elements within the model--more precisely undergraduate units and graduate student teaching effort. If an increase in undergraduate enrollment is predicted and no change in graduate enrollment, RRPM will indicate that an increase in graduate student teaching effort (and cost) is required.

". . .a valid cost model for instruction including such activity measures as departmental enrollment projections and faculty course loads would be of considerable value for planning purposes."

M. M. Roberts, Director
Administrative Computing
Stanford University

". . .I believe that the RRPM pilot test, which was our first acquaintance with a large model, to have been worth the time and effort expended, even though the results are disappointing in terms of their immediate utility to our budget group. I look forward to the promised refinements in its operation, both because of their ability to give a more detailed look at the future and the consequences of current budgetary decisions, as well as the insight they will provide into interrelationships among the key variables in our academic "mix," students, faculty, and their assoicated costs."

K. Creighton, Deputy Vice President
Stanford University

"The use of the Resource Requirements Predicition Model (RRPM) in actual administrative processes at SUNY at Stony Brook is promising though non-specific at this time. The data base required and the model validation are not sufficiently complete for full evaluation, having:

a. faltered because of the lack of adequate descriptors for a rapidly growing institution;
b. the desire to avoid a heavy bias of the future by the past;
c. the need for better model representation of actual university processes; and
d. the tight time scale which precluded substantial reaction from users.

However, Stony Brook is committed to development and implementation of appropriate component and systems models and will build on its RRPM Pilot Test experiences."

D. L. Trautman, Acting Director
of Long-Range Planning
SUNY at Stony Brook

"RRPM and other computer mechanisms are not a substitute for thoughtful planning. Computer programs are tools that can facilitate a logical management process; but the tools are not gimmicks which automatically produce sound plans.

There is a great deal more to planning and management than driving a computer model, but RRPM can be used by a creative manager as a focus for many important concerns. The manager can design a total process that relates operational institutional objectives with performance objectives for individuals, particularly dialogue around the calculations of RRPM can be used to test priorities and the commitment to act. To execute this kind of process effectively it is imperative that a broad spectrum be actively involved, and not only including top administration but also students, faculty, and staff.

Too often enrollment projections are ignored, are considered unimportant, or are mere numerical extrapolations of history. It is extremely important to reflect in meaningful projections an assessment of the job market for graduates and skill requirements for the jobs of the future; expert judgements should be

sought from department chairmen, deans, and administration; and projected growth in each area to be used for planning should be established by negotiation. This same kind of data should be shared with students through an effective counseling mechansim so that students can make informed and mature decisions about their own academic choices. Finally, we need to gain a better understanding of how students are motivated, and what it is that changes student flow patterns."

B. M. Cohn, Director
Long Range Planning
University of Utah

"We have submitted a number of "what if" questions to be answered by RRPM. Although the resulting predictions were not operationally useful, two classes of benefits occured. First, a better understanding of: 1) the kinds of questions which should be asked, 2) how to ask them, and 3) when RRPM offers a potential advantage over alternative techniques, was achieved. Second, RRPM was found useful in predicting extreme or limiting situations. An example was its use to predict total university cost, first assuming a six percent and then a zero percent inflation factor. The results were enlightening. In general, however, values obtained via RRPM are not sufficiently accurate to provide a sole or even primary basis for making operational decisions.

Dr. William Walden, Director
Systems and Computing
Washington State University

"It is essential that the results of RRPM be framed in terms of the organizational structure of a campus if decision making is to benefit from its existence. Where institutional standards are applied routinely in the allocation of resources, RRPM can be an invaluable tool.

Without fully understanding differences in programs among a variety of educational institutions, RRPM will not serve to facilitate inter-institutional information exchange."[8]

A. H. Harris, Director of Planning
U. C. L. A.

A concern expressed in many separate evaluation sessions is that the cost data from the RRPM-1 might be used by funding agencies as criteria of performance. Many users emphasized the the RRPM-1 cost data output is designed for internal analysis by an institution and is not designed as a basis of resource allocation among institutions.[9]

The pilot test of RRPM-1 indicated three principal applications of the model depending on the degree of analytical capability at the various institutions.

A. At some schools, the implementation exercise resulted in the development of a virtually new model. The application of RRPM-1 at the institution provided the stimulus for staff to consider new analytic techniques that would better model the unique structure and environment of the institution. Thus, RRPM-1 provided a foundation for advanced analytical development.

B. Other schools used the model as designed with some minor modifications. As a result, they were able to avoid the costly developmental expenses that would be incurred if they were required to expand their current analytical capabilities.

C. For at least one school, the implementation of RRPM-1 proved to be a valuable aid in defining and subsequently building a data base for the institution.

In all cases, the implementation of RRPM-1, as with most analytical tools, provided the means for a structured analysis of the institution. In attempting to model the institution, staff was required to examine critically the relationships between the various components of the institution and also to examine the characteristics of the institution. Thus, implementation of RRPM-1 led to a better understanding of the institution and in a few cases, resulted in some enlightening insights to the operations of the various segments of the institution.

7. Prerequisites and Required Resources

The pilot test experience has demonstrated that certain elements are required for a successful implementation of RRPM-1. These prerequisites include: top management commitment, adequate equipment, a data base, and competent personnel.[10] The most important condition is the first. Given the commitment of the campus executives, the others often are made available or become less important. For example, one pilot institution implementing RRPM-1 had top management support at both the institutional and state level. It then hired or borrowed its project personnel, obtained a grant for computer time from a sister institution in the state, and created all of its data base. Its implementation was successful.

Before management makes its commitment, however, it must carefully weigh the benefits of RRPM-1 against the costs. The costs are of two types: one, the initial cost of implementing RRPM-1, and two, the recurring costs of maintaining and using the model. The magnitude of each of these costs depends upon the environment for implementation at the institution and the commitment of its staff. The costs must be computed by one knowledgeable of the institution and experienced in systems projects. These costs will be much less than the costs incurred by the pilot institutions because the experimental nature of the pilot studies required additional effort. The cost of implementation is, however, highly dependent upon the extent of previous institutional commitment to analytical studies.

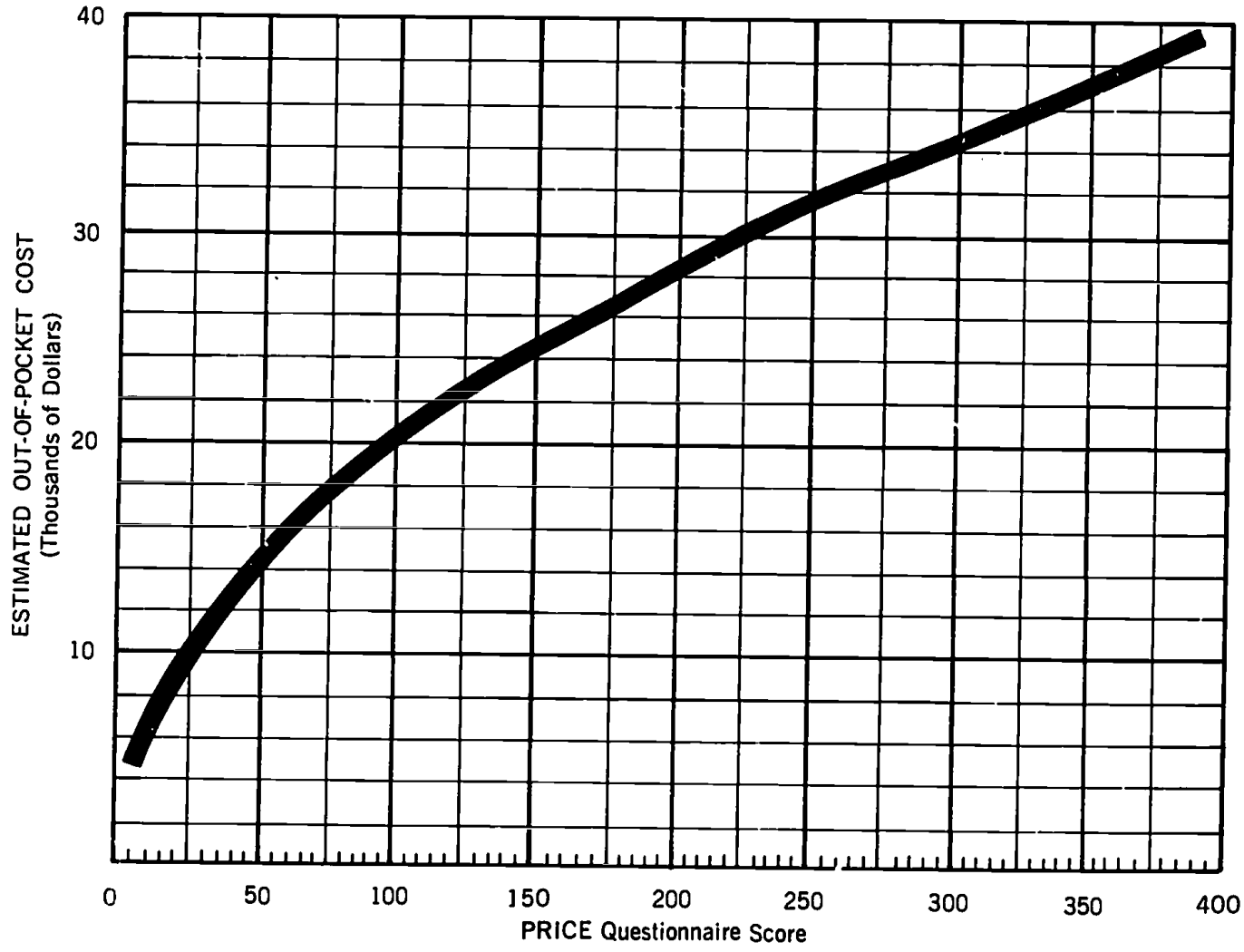
Implementation of RRPM-1 will probably require anywhere from three to nine months, depending on the availability of data and the commitment of the personnel. The cost of implementation is difficult to estimate because we have no experience with the "learning curve" resulting from the experiences of the pilot institutions as stated in the documentation of RRPM-1. It is, however, estimated by the project managers of pilot insitutions that the initial cost will be between $10,000 and $38,000 and that the annual recurring costs will be between $6,000 and $15,000. Both cost figures are out-of-pocket costs based on an ongoing analytical effort at the institution. In the case of the pilot institutions, the out-of-pocket costs were, on average, approximately 60% of the total costs and included largely personnel wages. The remainder was largely support and computer costs. These costs do no include the time spent by management in evaluating and using RRPM-1.

Utilizing the experience of the pilot test, a very rough estimating procedure has been developed to aid institutions in determing the magnitude of RRPM-1 implementation costs, both the initial expense and ongoing expense. This procedure (or cost model) is referred to as "PRICE," PRimitive Implementation Cost Estimator. It is emphasized that the PRICE technique is, in fact, quite primitive and should not be used as a budgeting device. It is provided merely as an aid to identifying the variables that will influence the cost of RRPM-1 implementation and as a guide to the relative magnitude of cost. The resulting estimate is a marginal out-of-pocket cost which assumes an existing analytical effort at the institution.

Institutions planning to implement RRPM-1 should develop a detailed budget estimate for both the initial expense and ongoing expense. In addition, it is recommended that a comprehensive work plan and staffing analysis be developed to insure that the cost estimates are realistic in light of the activities necessary for implementation. Again, PRICE is not a substitute for detailed planning, but is merely an aid to preliminary cost estimation.

To use the PRICE model, simply complete the PRICE questionnaire on the following page, separately adding the score for each section. Fill out the table at the bottom of the questionaire in order to determine the PRICE score for each type of cost. Note that Column I is used for estimating the initial cost of implementation, Column II is used for estimating the ongoing costs subsequent to implementation. The PRICE score is used with the graph in Figure 4 "PRimitive Implementation Cost Estimator" to develop a preliminary gross estimate by intersecting the graph line along the bottom scale at the point corresponding to the PRICE score and reading the corresponding dollar estimate on the left hand side. Both initial cost and ongoing cost are estimated from the same scales.

FIGURE 4
PRimitive Implementation Cost Estimator (PRICE)
for RRPM-1



PRimitive Implementation Cost Estimator (PRICE) Questionnaire

Circle the number in the appropriate column for each question. Add up the circled numbers for each of the four sections of the questionnaire. Compute columns I and II separately.

Large	Med.	Small	SECTION A. COMPLEXITY OF INSTITUTION
3	2	0	1. Size of Organized Research Program (none = small)
3	2	0	2. Size of Public Service Program (none = small)
3	2	1	3. Extent of curricula offering: (medium is approximately 200 courses per session)
3	2	1	4. Annual percentage change in environment over last five years: (medium is approximately 10%)
3	2	1	5. Levels of hierarchial organization between faculty and president: (medium is 3 levels)
3	2	1	6. Institution's relevant dimensions compared with model maximums: (large is equal or greater than model, medium is slightly less)
			SUBTOTAL A

Com-plete	Par.	None	SECTION B. ESTABLISHING THE DATA BASE (in machine readable form). Are the following items presently available completely, partially or not at all?
1	3	5	1. Induced course load matrix?
1	3	3	2. Historical Cost Data on Instructional Support program?
1	2	4	3. Other RRPM data? (defined in Manual)
1	2	3	4. RRPM data in integrated files?
1	2	3	5. RRPM data validated?
			SUBTOTAL B

Much	Av.	Ltle.	SECTION C. PERSONNEL AVAILABILITY FOR RRPM-I AT THE INSTITUTION
1	2	3	1. Extent of their knowledge of decision making at the institution.
1	2	3	2. Extent of their background in statistics (Regression analysis and estimation).
1	2	3	3. Extent of experience in designing computerized information systems.
1	2	3	4. Extent of project management experience.
1	2	3	5. Extent of experience in planning and modelling at the institution.
			SUBTOTAL C

Yes	No	SECTION D. EQUIPMENT
1	3	1. Is there random access capability?
1	3	2. Is the computer system to be used for RRPM-I on campus?
1	3	3. Is there a one night, or less, turn-around time?
		SUBTOTAL D

COLUMN I - INITIAL COST

Subtotal A ____

Subtotal B ____

PRODUCT (AxB) ____

Subtotal C ____ X 2 ____

Subtotal D ____

PRICE Score:

Sum (AxB+2C+D) ____

COLUMN II - ON-GOING COST

Subtotal A ____ X 2 ____

Subtotal B - 0 - - 0 -

Subtotal C ____

Subtotal D ____ X 2 ____

PRICE Score:

Sum (2A+C+2D) ____

In many cases, benefits of RRPM-1 are savings in dollars and these can be estimated. Often, however, the benefits of planning information are intangible and cannot be given a dollar value. Management then must weigh these benefits against the costs and determine whether or not they are worth it. They must look at the model critically and ask questions such as: Are the assumptions of the model valid for the institution? Are the planning variables of the institution also "variables" in the model? Is the model relevant? Does it "fit" in the decision-making process of the institution? Does it address the questions for which answers are needed by the institution? Will the implementation of the model have a positive benefit to cost ratio? Is it financially, technologically and organizationally feasible for the institution?

If the answer to one or more of the above questions is in the negative, then the wisdom of implementing the model must be seriously examined. If the answers to the questions are in the affirmative, and management is willing to commit the necessary resources for implementation, then the decision should be made to implement.

If a decision is made to implement RRPM-1, then the resources necessary for implementation must be authorized and a project manager must be appointed. Typically, this person is experienced in modeling and project management, knowledgeable of computerized information systems, knowledgeable of the decision-making structure of the institution, and he has the confidence of top management. The project manager must also have the ability of working with people, because RRPM-1 is a man-machine system where the "man" component is very important. It is the project manager who provides the inputs and interprets the outputs.

The functional location of the project manager has varied greatly among the pilot institutions. Three came from the department of long-range planning, two from administrative data processing, and one from institutional research. One was a vice president of administration, and one came from the ranks of the faculty. In general, the location of the project manager is not important provided that he has direct access to the campus decision makers.

An "analytical team" should be appointed to work with the project manager. The function of this group is to aid the project manager by: (a) restating the institutional policies in operational terms, (b) specifying modifications necessary to the model, (c) determining the values of planning variables that are inputs to the model, and (d) checking and evaluating the model output. To perform this task, the analytical team must have as its members representatives of top and middle management. Their commitment of time needed for this task must be recognized since such commitment is essential for a successful implementation of RRPM-1. It is also important that management personnel allocate their time and effort in understanding RRPM-1. R. J. Low,[11] Vice-President for Administration at one of the pilot institutions, states the need as follows:

"It is important for the president and provost or academic vice president and persons at that level to understand, conceptually, how RRPM works, although there is no need for the executives to comprehend the technical details of the computer programs. Moreover, they need to know what it will do and, especially, what its limitations are. Indeed, perhaps the greatest risk in not knowing the conceptual anatomy of RRPM is that too much reliance may be placed on its numerical results; the character of its limitations may not be sufficiently recognized; expectations might be lifted to unwarranted levels and not fulfilled.

It is important, therefore, for a wide range of decision makers--department chairmen, deans, and directors, in addition to the top administration--to be trained in what RRPM will do. They need, in addition, to be invited to participate in the planning process and in the numerical manipulations that RRPM will make possible. This is needed to provide the widest possible input into the planning process and to produce a sense of involvement with administration in it. Otherwise, RRPM will undoubtedly be seen as a threat and as another device in the hands of administration to be used against the faculty rather than for them to help the entire academic community do a better job of planning, management, and resource allocation."

The involvement of relevant personnel in the process of planning can be partially achieved through the "analytical team." This approach was taken by each of the pilot institutions. In each case, the initial team consisted of:

a. Senior executive officer for academic affairs
b. Senior executive officer for business or finance
d. Budget Officer
e. Information systems coordinator or analyst
f. Qualified technical analyst
g. Research assistant
h. Computer programmer

Some pilot institutions found the team too large and worked with a subset of the group. Other pilot institutions expanded the team by adding deans and faculty members to it. This addition is recommended not only because it represents an important sector of the academic community, but also because it can be a source of much know-how and experience. This is especially true of institutions that have strong academic departments in economics, industrial engineering, business administration, computer science, and educational administration.

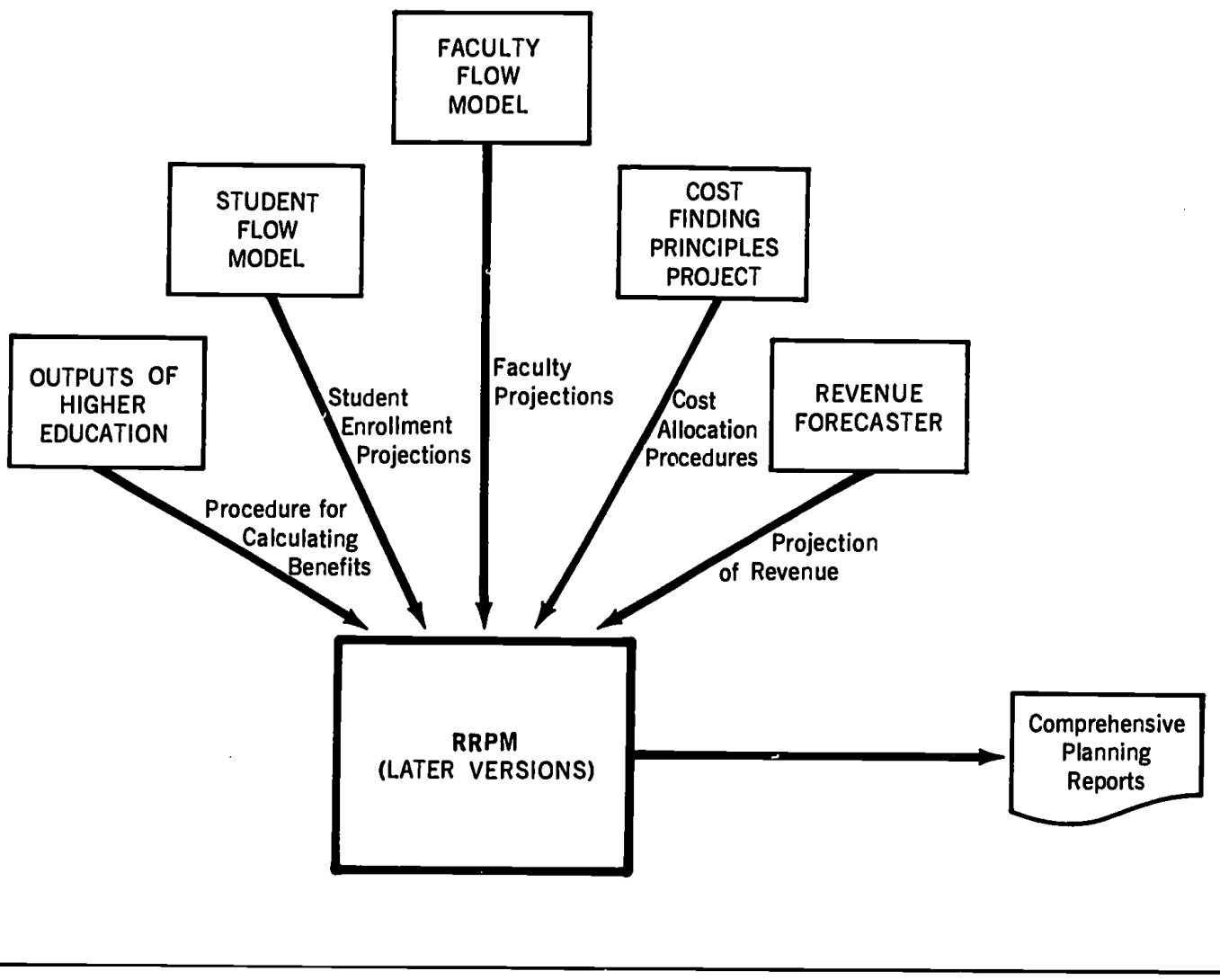
In addition to a project manager and his analytical team, there are other resources needed for the implementation of RRPM-1. These may include such technical personnel as an analyst and/or a programmer. Also required will be a medium-scale computer or access to one. If not available on campus, the programmer can be hired while computer time can be borrowed or bought. Marshaling of the necessary resources is the job of the project manager. In order to aid him with these and other problems, NCHEMS has prepared a Guide for the Project Manager.[12] Other managers, such as readers of this document, should also read the Guide even though they may not have knowledge of computer processing and modeling and may not understand some of the technical discussion. Nevertheless the Guide is recommended as an aid to understanding the structure of RRPM-1 and the process of implementing the model. Also of interest to the manager will be the Report on the Pilot Studies.[13] It discusses the development of the RRPM-1 model and the experiences of the pilot institutions testing the model.

8. Future Developments

The earlier discussion of the design criteria pointed out that RRPM-1 has limited objectives and hence is a somewhat simplified model, though not necessarily a simple one. Some of the simplifications are: no calculations of benefits (because of the need to identify and measure outputs of education); treatment of student enrollment as externally determined instead of calculating its value by a student flow model; simplified calculations of faculty required without tracing faculty flow; allocation of support costs to primary programs by arbitrary allocation procedures; and finally, no attention to the revenue sector of education. Each of these simplifications is actually a very important and difficult issue. All are therefore the subject of separate efforts under NCHEMS. In each case, these products are being developed in such a manner that they can be used in conjunction with RRPM-1. Therefore, it is anticipated that future versions of the model will be more comprehensive and useful to educational decision making. The relationship of the different NCHEMS projects to RRPM-1 is shown diagrammatically in Figure 5.

Other refinements and extensions of the model will include the development of a short-term budget estimator, "PROgram Budget Estimator," which is referred to as PROBE. This model will be designed to facilitate college and university budgeting on a program basis. The Center plans to develop a statewide or multi-institution RRPM and has proposed the development of a national model. In addition, work is underway within the NCHEMS Research program to investigate various forms of resource allocation and decision models. As this work progresses, it will be reflected in later versions of RRPM.

FIGURE 5
FUTURE DEVELOPMENTS RELATED TO RRPM



Appendix A

Sample of Standard Reports

(RRPM-1.3 in the Predictive Mode)

Appendix A - Samples of Standard Reports

This appendix displays samples of each type of standard report generated by RRPM-1.3. The standard reports are produced in the predictive mode for a simulation over one to ten years. Reports produced in the experimental mode (shown in Appendix B) may be used to examine the consequences of changing various planning parameters. The data set used is the RRPM-1 test data set based on a hypothetical institution called MICRO-U II, which is a small university with 11 departments, 14 disciplines, 3 instruction types, 3 student levels, 3 course levels, and 5 faculty levels. The loading factors and coefficients in the test data set are arbitrary values used to represent a "typical" institution of higher education.

Report Type	Report Title	Reporting Level
01	FTE & Costs (of Personnel)	Subprogram and Department/ Discipline
02	Student Load	Instruction Subprograms by Department/Discipline
03	Faculty Load	Instruction Subprograms by Department/Discipline
04	Space Requirements	Subprogram and Department/ Discipline
05	Construction Costs	Total Institution
06	Enrollments	Total Instruction Program
07	Cost per Credit Hour	Instruction Subprogramd by Department/Discipline
08	Cost per Student	Instruction Subprograms by Student Field of Study

The sample of report types 01, 02, 03, and 04 are generated for the department of history but could as well have been generated for any department or other level of aggregation (i.e., school, college or campus) or disaggregation (i.e., discipline). Report types 01 and 04 are also produced for each PCS subprogram and department/discipline where appropriate. Report types 05 and 06 are for the entire campus. There are no levels of aggregation or disaggreation for these reports. However, enrollments by student field and level are displayed within report type 08, Cost per Student. Report type 07 shows the cost of instruction in the department of history. Report type 08 is the cost of instruction for students majoring in history. This report may be produced for any field of study.

SAMPLE STAN

NCHEMS RRPM-1.3 — M I C R O - U - I I — DATE 09/06/71

HISTORY | SPACE REQUIREMENTS | PROGRAM 1.0 INSTRUCTION | SUB-PROGRAM 1.1

SPACE REQUIREMENTS
CLASSROOM
CLASS LABORATORY
RESEARCH LABORATORY
OFFICE + CONFERENCE
LIBRARY
MUSEUM/GALLERY
AUDIO/VISUAL
DATA PROC/COMPUTER
ARMORY
CLINIC
DEMONSTRATION
FIELD SERVICE
ATHLETIC-PHYS. ED.
ASSEMBLY
LOUNGE
MERCHANDISING
RECREATION
RESIDENTIAL
DINING
STUDENT HEALTH
MEDICAL CARE
PHYSICAL PLANT
**** TOTAL

NCHEMS RRPM-1.3 — M I C R O - U - I I

HISTORY | FACULTY LOAD | PROGRAM 1.0 INSTRUCTION

FACULTY CONTACT HOURS

LOWER DIVISION
CLASSROOM
LABORATORY + DEMO
OTHER INSTRUCTION
**** TOTAL

UPPER DIVISION
CLASSROOM
LABORATORY + DEMO
OTHER INSTRUCTION
**** TOTAL

GRADUATE
CLASSROOM
LABORATORY + DEMO
OTHER INSTRUCTION
**** TOTAL

SUMMARY

CLASSROOM
LABORATORY + DEMO
OTHER INSTRUCTION
**** TOTAL

NCHEMS RRPM-1.3

HISTORY | STUDENT LOAD

STUDENT CREDIT HOURS
LOWER DIVISION
UPPER DIVISION
GRADUATE
**** TOTAL

STUDENT CONTACT HOURS

LOWER DIVISION
CLASSROOM
LABORATORY + DEMO
OTHER INSTRUCTION
**** TOTAL

UPPER DIVISION
CLASSROOM
LABORATORY + DEMO
OTHER INSTRUCTION
**** TOTAL

GRADUATE
CLASSROOM
LABORATORY + DEMO
OTHER INSTRUCTION
**** TOTAL

SUMMARY

CLASSROOM
LABORATORY + DEMO
OTHER INSTRUCTION
**** TOTAL

NCHEMS RRPM-1.3

HISTORY

ACADEMIC FACULTY FTE
PROFESSOR
ASSOCIATE PROFESSO
ASSISTANT PROFESSO
INSTR/LECT/RES ASS
TEACHING GRAD ASST
NON-TEACH GRAD ASS
**** TOTAL

ACADEMIC FACULTY SAL
PROFESSOR
ASSOCIATE PROFESSO
ASSISTANT PROFESS
INSTR/LECT/RES ASS
TEACHING GRAD ASST
NON-TEACH GRAD ASS
**** TOTAL

NONACADEMIC FTE
PROFESSIONAL/MGMT
TECHNICAL/CRAFTSMA
SECRETARIAL-CLERIC
UNSKILLED/SEMI-SKI
**** TOTAL

NONACADEMIC SALARIES
PROFESSIONAL/MGMT
TECHNICAL/CRAFTSMA
SECRETARIAL-CLERIC
UNSKILLED/SEMI-SKI
**** TOTAL

TOTAL PERSONNEL FTE

TOTAL PERSONNEL $

SUPPLY EXPENSE

TRAVEL EXPENSE

EQUIPMENT EXPENSE

TOTAL DOLLARS

SAMPLE STANDARD REPORTS

C R O - U I I DATE 08/06/71 RUN NUMBER 01 PAGE 8
REPORT CODE 1.1 .01.04

PROGRAM 1.0 INSTRUCTION SUB-PROGRAM 1.1 GENERAL ACADEMIC

M I C R O - U I I DATE 08/06/71 RUN NUMBER 01 PAGE 7
REPORT CODE 1.1 .01.03

FACULTY LOAD PROGRAM 1.0 INSTRUCTION SUB-PROGRAM 1.1 GENERAL ACADEMIC

NCHEMS RRPM-1.3 M I C R O - U I I DATE 08/06/71 RUN NUMBE
REPORT

HISTORY STUDENT LOAD PROGRAM 1.0 INSTRUCTION SUB-PROGRAM 1.1 GENERAL AC

NCHEMS RRPM-1.3 M I C R O - U I I

HISTORY FTE + COST PROGRAM 1.0 INSTRUCTION

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
STUDENT CREDIT HOURS					
LOWER DIVISION					
UPPER DIVISION					
GRADUATE					
**** TOTAL					
STUDENT CONTACT HOURS					
LOWER DIVISION					
CLASSROOM					
LABORATORY + DEMO					
OTHER INSTRUCTION					
**** TOTAL					
UPPER DIVISION					
CLASSROOM					
LABORATORY + DEMO					
OTHER INSTRUCTION					
**** TOTAL					
GRADUATE					
CLASSROOM					
LABORATORY + DEMO					
OTHER INSTRUCTION					
**** TOTAL					
SUMMARY					
CLASSROOM					
LABORATORY + DEMO					
OTHER INSTRUCTION					
**** TOTAL					
ACADEMIC FACULTY FTE					
PROFESSOR	2.5	2.8	5.0	5.0	4.5
ASSOCIATE PROFESSO	3.1	3.5	6.1	6.1	5.5
ASSISTANT PROFESSO	2.7	3.0	5.0	5.0	4.5
INSTR/LECT/RES ASS	1.0	1.1	1.9	1.8	1.4
TEACHING GRAD ASST	.6	.7	1.0	1.0	.9
NON-TEACH GRAD ASS					
**** TOTAL	9.9	11.1	18.9	18.9	17.0
ACADEMIC FACULTY SALARIES					
PROFESSOR	$42,774	$47,527	$84,520	$84,520	$76,068
ASSOCIATE PROFESSO	$45,084	$50,093	$88,719	$88,719	$79,847
ASSISTANT PROFESSO	$31,109	$34,565	$58,067	$58,067	$52,260
INSTR/LECT/RES ASS	$9,689	$10,766	$16,859	$16,959	$15,173
TEACHING GRAD ASST	$4,191	$4,657	$6,995	$6,985	$6,287
NON-TEACH GRAD ASS					
**** TOTAL	$132,847	$147,608	$255,150	$255,150	$229,635
NONACADEMIC FTE					
PROFESSIONAL/MGMT					
TECHNICAL/CRAFTSMA					
SECRETARIAL-CLERIC	3.1	3.4	5.8	5.8	5.3
UNSKILLED/SEMI-SKI					
**** TOTAL	3.1	3.4	5.8	5.8	5.3
NONACADEMIC SALARIES					
PROFESSIONAL/MGMT					
TECHNICAL/CRAFTSMA					
SECRETARIAL-CLERIC	$15,656	$17,395	$29,753	$29,753	$26,778
UNSKILLED/SEMI-SKI					
**** TOTAL	$15,656	$17,395	$29,753	$29,753	$26,778
TOTAL PERSONNEL FTE	13.0	14.5	24.7	24.7	22.3
TOTAL PERSONNEL $	$148,503	$165,003	$284,903	$284,903	$256,413
SUPPLY EXPENSE	$3,191	$3,149	$3,486	$3,486	$3,405
TRAVEL EXPENSE	$1,949	$2,088	$3,074	$3,074	$2,837
EQUIPMENT EXPENSE	$1,855	$1,950	$2,625	$2,625	$2,463
TOTAL DOLLARS	$155,408	$172,190	$294,088	$294,088	$265,118

ARD REPORTS

NERAL ACADEMIC

SUB-PROGRAM 1.1 GENERAL ACADEMIC

PROGRAM 1.0 INSTRUCTION SUB-PROGRAM 1.1 GENERAL ACADEMIC

FTE + COST PROGRAM 1.0 INSTRUCTION SUB-PROGRAM 1.1 GENERAL ACADEMIC

YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
2.5	2.8	5.0	5.0	4.5
5.1	3.5	6.1	6.1	5.5
2.7	3.0	5.0	5.0	4.5
1.0	1.1	1.8	1.8	1.6
.6	.7	1.0	1.0	.9
9.0	11.1	18.9	18.9	17.0
S				
$42,774	$47,527	$84,520	$84,520	$76,068
$45,084	$50,093	$88,719	$88,719	$79,847
$31,109	$34,565	$58,067	$58,067	$52,260
$9,689	$10,766	$16,859	$16,859	$15,173
$4,191	$4,657	$6,985	$6,985	$6,287
$132,847	$147,608	$255,150	$255,150	$229,635
3.1	3.4	5.8	5.8	5.3
3.1	3.4	5.8	5.8	5.3
$15,656	$17,395	$29,753	$29,753	$26,778
$15,656	$17,395	$29,753	$29,753	$26,778
13.0	14.5	24.7	24.7	22.3
$148,503	$165,003	$284,903	$284,903	$256,413
$3,101	$3,149	$3,486	$3,486	$3,405
$1,949	$2,088	$3,074	$3,074	$2,837
$1,855	$1,950	$2,625	$2,625	$2,463
$155,408	$172,190	$294,088	$294,088	$265,118

SAMPLE STAND

NCHEMS RRPM-1.3

M I C R O - U I I

DATE 08/

SUPPORT PROGRAM — CONSTRUCTION COSTS — PROGRAM *.* — SUB-PROGRA

CONSTRUCTION COSTS
CLASSROOM
CLASS LABORATORY
RESEARCH LABORATORY
OFFICE + CONFERENCE
LIBRARY
MUSEUM/GALLERY
AUDIO/VISUAL
DATA PROC/COMPUTER
ARMORY
CLINIC
DEMONSTRATION
FIELD SERVICE
ATHLETIC-PHYS. ED.
ASSEMBLY
LOUNGE
MERCHANDISING
RECREATION
RESIDENTIAL
DINING
STUDENT HEALTH
MEDICAL CARE
PHYSICAL PLANT
**** TOTAL

NCHEMS RRPM-1.3

M I C R O - U I I

ENROLLMENTS — PROGRAM *.*

STUDENT ENROLLMENTS
GENERAL ACADEMIC
LOWER DIVISION
UPPER DIVISION
GRADUATE
SPECIAL
**** TOTAL

OCCUPAT/VOTECH
LOWER DIVISION
UPPER DIVISION
GRADUATE
SPECIAL
**** TOTAL

SPECIAL SESSION

EXTENSION

**** GRAND TOTAL

NCHEMS RRPM-1.3

HISTORY — COST PER CREDIT HOU

LOWER DIVISION

DIRECT COST
ALLOCATED COST
TOTAL COST

STUDENT CREDIT HRS

DIRECT COST/SCH
ALLOCATED COST/SCH
TOTAL COSTS/SCH

UPPER DIVISION

DIRECT COST
ALLOCATED COST
TOTAL COST

STUDENT CREDIT HRS

DIRECT COST/SCH
ALLOCATED COST/SCH
TOTAL COSTS/SCH

GRADUATE

DIRECT COST
ALLOCATED COST
TOTAL COST

STUDENT CREDIT HRS

DIRECT COST/SCH
ALLOCATED COST/SCH
TOTAL COSTS/SCH

NCHEMS RRPM-1.3

HISTORY

LOWER DIVISION

DIRECT COST
ALLOCATED-COST
INDIRECT COST
TOTAL COST

NUMBER OF STUDE

DIRECT COST/STU
ALLOCATED COST/
INDIRECT COST/S
TOTAL COST/STU

UPPER DIVISION

DIRECT COST
ALLOCATED-COST
INDIRECT COST
TOTAL COST

NUMBER OF STUDE

DIRECT COST/STU
ALLOCATED COST/
INDIRECT COST/S
TOTAL COST/STU

GRADUATE

DIRECT COST
ALLOCATED-COST
INDIRECT COST
TOTAL COST

NUMBER OF STUDE

DIRECT COST/STU
ALLOCATED COST/
INDIRECT COST/S
TOTAL COST/STU

SAMPLE STANDARD REPORTS (Continued)

M I C R O - U I I DATE 08/06/71 RUN NUMBER 01 PAGE 124
REPORT CODE 0.0 .00.05

PROGRAM *.* SUB-PROGRAM *.*

M I C R O - U I I DATE 08/06/71 RUN NUMBER 01 PAGE 123
REPORT CODE 0.0 .00.06

ENROLLMENTS PROGRAM *.* SUB-PROGRAM *.*

NCHEMS RRPM-1.3 M I C R O - U I I DATE 08/06/71 RUN NUM
REPOR

HISTORY COST PER CREDIT HOUR PROGRAM 1.0 INSTRUCTION SUB-PROGRAM 1.1 GENERAL

LOWER DIVISION

DIRECT COST
ALLOCATED COST
TOTAL COST

STUDENT CREDIT HRS

DIRECT COST/SCH
ALLOCATED COST/SCH
TOTAL COSTS/SCH

UPPER DIVISION

DIRECT COST
ALLOCATED COST
TOTAL COST

STUDENT CREDIT HRS

DIRECT COST/SCH
ALLOCATED COST/SCH
TOTAL COSTS/SCH

GRADUATE

DIRECT COST
ALLOCATED COST
TOTAL COST

STUDENT CREDIT HRS

DIRECT COST/SCH
ALLOCATED COST/SCH
TOTAL COSTS/SCH

NCHEMS RRPM-1.3 M I C R O - U I I

HISTORY COST PER STUDENT PROGRAM 1.0 INSTRUCTION

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
LOWER DIVISION					
DIRECT COST	$53,186	$58,772	$88,157	$88,948	$80,325
ALLOCATED-COST	$86,481	$88,555	$89,580	$89,997	$86,848
INDIRECT COST	$143,872	$143,872	$143,872	$143,872	$143,872
TOTAL COST	$283,539	$291,199	$321,609	$322,817	$311,045
NUMBER OF STUDENTS	74	74	74	74	74
DIRECT COST/STU	$718.70	$794.20	$1,191.30	$1,202.00	$1,085.40
ALLOCATED COST/STU	$1,168.60	$1,196.60	$1,210.50	$1,216.10	$1,173.60
INDIRECT COST/STU	$1,944.20	$1,944.20	$1,944.20	$1,944.20	$1,944.20
TOTAL COST/STU	$3,831.60	$3,935.10	$4,346.00	$4,362.30	$4,203.30
UPPER DIVISION					
DIRECT COST	$81,201	$89,927	$146,727	$146,789	$132,364
ALLOCATED-COST	$132,252	$135,716	$149,299	$148,724	$143,318
INDIRECT COST	$169,147	$169,147	$169,147	$169,147	$169,147
TOTAL COST	$382,600	$394,790	$465,173	$464,660	$444,829
NUMBER OF STUDENTS	87	87	87	87	87
DIRECT COST/STU	$933.30	$1,033.60	$1,686.50	$1,687.20	$1,521.40
ALLOCATED COST/STU	$1,520.10	$1,559.90	$1,716.00	$1,709.40	$1,647.30
INDIRECT COST/STU	$1,944.20	$1,944.20	$1,944.20	$1,944.20	$1,944.20
TOTAL COST/STU	$4,397.70	$4,537.90	$5,346.80	$5,340.90	$5,112.90
GRADUATE					
DIRECT COST	$31,998	$35,453	$69,116	$69,116	$62,302
ALLOCATED-COST	$52,132	$53,530	$70,346	$70,046	$67,477
INDIRECT COST	$50,550	$50,550	$50,550	$50,550	$50,550
TOTAL COST	$134,680	$139,533	$190,012	$189,712	$180,329
NUMBER OF STUDENTS	26	26	26	26	26
DIRECT COST/STU	$1,230.60	$1,363.70	$2,658.30	$2,658.30	$2,396.20
ALLOCATED COST/STU	$2,005.00	$2,059.80	$2,705.30	$2,694.00	$2,595.20
INDIRECT COST/STU	$1,944.20	$1,944.20	$1,944.20	$1,944.20	$1,944.20
TOTAL COST/STU	$5,180.00	$5,366.80	$7,308.10	$7,296.50	$6,935.70

ARD REPORTS (Continued)

6/71 RUN NUMBER 01 PAGE 124
REPORT CODE 0.0 .00.05

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DATE 08/06/71 RUN NUMBER 01 PAGE 123
REPORT CODE 0.0 .00.06

SUB-PROGRAM *.*

M I C R O - U I I

DATE 08/06/71 RUN NUMBER 01 PAGE 125
REPORT CODE 1.1 .01.07

PROGRAM 1.0 INSTRUCTION SUB-PROGRAM 1.1 GENERAL ACADEMIC

M I C R O - U I I

DATE 08/06/71 RUN NUMBER 01 PAGE 15
REPORT CODE 1.1 .01.0

COST PER STUDENT PROGRAM 1.0 INSTRUCTION SUB-PROGRAM 1.1 GENERAL ACADEMIC

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
	$53,186	$58,772	$88,157	$88,948	$80,325
	$36,481	$88,555	$89,580	$89,997	$86,848
	$143,872	$143,872	$143,872	$143,872	$143,872
	$283,539	$291,199	$321,609	$322,817	$311,045
NTS	74	74	74	74	74
	$718.70	$794.20	$1,191.30	$1,202.00	$1,085.40
STU	$1,168.60	$1,196.60	$1,210.50	$1,216.10	$1,173.60
TU	$1,944.20	$1,944.20	$1,944.20	$1,944.20	$1,944.20
	$3,831.60	$3,935.10	$4,346.00	$4,362.30	$4,203.30
	$81,201	$89,927	$146,727	$146,789	$132,364
	$132,252	$135,716	$149,299	$148,724	$143,318
	$169,147	$169,147	$169,147	$169,147	$169,147
	$382,600	$394,790	$465,173	$464,660	$444,829
NTS	87	87	87	87	87
	$933.30	$1,033.60	$1,686.50	$1,687.20	$1,521.40
STU	$1,520.10	$1,559.90	$1,716.00	$1,709.40	$1,647.30
TU	$1,944.20	$1,944.20	$1,944.20	$1,944.20	$1,944.20
	$4,397.70	$4,537.90	$5,346.80	$5,340.90	$5,112.90
	$31,998	$35,453	$69,116	$69,116	$62,302
	$52,132	$53,530	$70,346	$70,046	$67,477
	$50,550	$50,550	$50,550	$50,550	$50,550
	$134,680	$139,534	$190,012	$189,712	$180,329
TS	26	26	26	26	26
	$1,230.60	$1,363.70	$2,658.30	$2,658.30	$2,396.20
TU	$2,005.00	$2,058.80	$2,705.30	$2,694.00	$2,595.70
U	$1,944.20	$1,944.20	$1,944.20	$1,944.20	$1,944.20
	$5,180.00	$5,366.80	$7,308.10	$7,296.50	$6,935.70

Appendix B

Sample of Experimental Case Report

(Alternative Policy Implications - RRPM-1.3 in Experimental Mode)

Appendix B - Sample of Experimental Case Report

RRPM-1.3 has the capability of answering "what if" type questions. In the experimental mode, a single simulation run may be used for up to ten experimental cases. For more cases, additional runs must be made. The resource implications of parameter changes may be computed and compared with a base case. A sample report type 01, FTE and Cost, is shown on the following page. This report is produced for the experimental cases below, using the test data set. Each of the reports discussed in Appendix A may be produced under the experimental mode for the various levels of data aggregation. Such reports may be used to evaluate the resource implications of alternative policies, such as the following:

Base: Same data that produced reports in Appendix A.

Case 1. Increment of +1 Contact Hour of the Faculty Load for the entire institution.

Case 2. Increment of +2 Contact Hour of the Faculty Load for the entire institution.

Case 3. Decrease by 10% Student Enrollment all majors.

Case 4. Increase by 10% Faculty Salaries in the Mathematics Department.

Case 5. Increase by 10% the Average Section Size in the Mathematics Department.

Case 6. Replace the constant coefficient (0.5 FTE) in the estimation equation for Secretaries in the Instruction Program.

Case 7. Add a new variable coefficient (0.2) for faculty FTE in the estimation equation for Secretaries in the Instructional Program.

Case 8. Combine Cases 6 and 7.

Case 9. Create a new major "Sociology" with enrollment as follows:

Lower Division = 35
Upper Division = 16
Graduate = 8

These cases represent many different types of changes: an absolute change in a variable (Cases 1 & 2); a percentage change (Cases 3, 4 & 5); replacement change (Case 6); an addition of values (Cases 7 & 9); changes for the entire institution (Cases 1, 2 & 3); changes in any one department (or discipline) (Cases 4, 5); changes in base year (Cases 1, 3 & 9): more than one change in the same variable (i.e., some sensitivity analysis of one variable: faculty load) (Cases 1 & 2); changes in the estimation equation (Cases 6, 7, 8); single changes (Cases 1 - 7 & 9); and finally, cumulative changes (Case 9). A further discussion of the changes that are possible appears in the Guide.[14]

SAMPLE EXPERIMENTAL CASE REPORTS

NCHEMS RRPM-1.3

DATE 10/12/71 RUN NUMBER 01 PAGE 1
REPORT CODE 1.1 .00.01

M I C R O - U I I
ALTERNATIVE POLICY IMPLICATIONS

SUMMARY REPORT — FTE + COST — PROGRAM 1.0 INSTRUCTION — SUB-PROGRAM 1.1 GENERAL ACADEMIC

	BASE	CASE1	CASE2	CASE3	CASE4	CASE5	CASE6	CASE7	CASE8	CASE9
ACADEMIC FACULTY FTE										
PROFESSOR	19.1	17.4	15.7	17.0	18.9	18.9	18.9	18.9	18.9	20.2
ASSOCIATE PROFESSO	25.6	23.0	20.9	22.8	25.2	25.1	25.2	25.2	25.2	27.2
ASSISTANT PROFESSO	25.1	22.7	21.0	22.5	24.7	24.6	24.7	24.7	24.7	27.0
INSTR/LECT/RES ASS	13.5	9.5	8.9	12.1	13.4	13.2	13.4	13.4	13.4	15.4
TEACHING GRAD ASST	12.6	4.0	3.7	11.3	12.4	12.4	12.4	12.4	12.4	14.8
**** TOTAL	95.9	76.6	70.2	85.7	94.6	94.1	94.6	94.6	94.6	104.6
ACADEMIC FACULTY SALARIES										
PROFESSOR	$338,843	$304,710	$276,974	$302,035	$333,450	$329,791	$331,534	$331,534	$331,534	$357,052
ASSOCIATE PROFESSO	$382,007	$344,669	$314,152	$340,509	$376,366	$371,954	$374,056	$374,056	$374,056	$407,563
ASSISTANT PROFESSO	$294,469	$266,984	$244,299	$262,618	$290,436	$287,166	$288,724	$288,724	$288,724	$318,885
INSTR/LECT/RES ASS	$129,416	$90,408	$83,532	$115,340	$128,399	$125,765	$127,020	$127,020	$127,020	$148,961
TEACHING GRAD ASST	$72,924	$24,647	$24,621	$64,829	$71,532	$71,532	$71,532	$71,532	$71,532	$81,843
**** TOTAL	$1,217,659	$1,033,418	$943,578	$1,085,331	$1,200,183	$1,186,208	$1,192,866	$1,192,866	$1,192,866	$1,314,304
NONACADEMIC FTE										
PROFESSIONAL/MGMT										
TECHNICAL/CRAFTSMA										
SECRETARIAL-CLERIC	30.1	24.1	22.0	27.2	29.7	29.5	36.7	48.1	55.1	32.9
UNSKILLED/SEMI-SKI										
**** TOTAL	30.1	24.1	22.0	27.2	29.7	29.5	36.7	48.1	55.1	32.9
NONACADEMIC SALARIES										
PROFESSIONAL/MGMT										
TECHNICAL/CRAFTSMA										
SECRETARIAL-CLERIC	$155,342	$123,183	$112,475	$138,426	$152,211	$151,370	$188,162	$246,193	$282,143	$169,278
UNSKILLED)/SEMI-SKI										
**** TOTAL	$155,342	$123,183	$112,475	$138,426	$152,211	$151,370	$188,162	$246,193	$282,143	$169,278
TOTAL PERSONNEL FTE	126.0	100.7	92.2	112.9	124.3	123.6	131.3	142.7	149.7	137.5
TOTAL PERSONNEL $	$1,373,001	$1,156,601	$1,056,053	$1,223,757	$1,352,394	$1,337,578	$1,381,028	$1,439,059	$1,475,009	$1,483,582
SUPPLY EXPENSE	$46,710	$44,360	$43,460	$44,627	$46,267	$46,223	$46,930	$47,923	$48,585	$48,069
TRAVEL EXPENSE	$21,656	$18,937	$18,024	$20,063	$21,369	$21,306	$21,668	$22,195	$22,493	$22,797
EQUIPMENT EXPENSE	$45,018	$42,093	$41,036	$43,144	$44,643	$44,579	$45,292	$46,299	$46,949	$46,646
TOTAL DOLLARS	$1,486,385	$1,261,991	$1,158,573	$1,331,611	$1,464,673	$1,449,686	$1,494,918	$1,555,476	$1,593,036	$1,601,094

APPENDIX C

RESOURCE REQUIREMENTS PREDICTION MODEL

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REFERENCES

1. See A Resource Requirement Prediction Model (RRPM-1) --Programmer's Manual, NCHEMS Technical Report 22, and A Resource Requirement Prediction Model (RRPM-1) --Guide for the Project Manager, NCHEMS Technical Report 20, (Boulder, Colo.: NCHEMS, 1971).

2. J. W. Schmidt and R. E. Taylor, Simulation Analysis of Industrial Systems, (Homewood, Ill.: Richard D. Irwin, Inc., 1970), p. 4.

3. NCHEMS Technical Report 20, op. cit.

4. George B. Weathersby, "Development and Application of a University Cost Simulation Model," an unpublished monograph, (Berkeley, California: Office of Analytical Studies, 1967).

5. Charles R. Thomas, Data Element Dictionary: Students, Staff, Facilities, Course, Finance: First Edition. (Boulder, Colo.: NCHEMS, February 1970.) These dictionaries are frequently updated.

6. Warren W. Gulko, Program Classification Structure: First Edition, (Boulder, Colo.: NCHEMS, 1971).

7. These extractions are from the statements made at meetings or in summary reports as they appear in A Resource Requirement Prediction Model (RRPM-1) --Report on the Pilot Studies, NCHEMS Technical Report 21, (Boulder, Colo.: NCHEMS, 1971) or in detailed reports on implementation deposited at the NCHEMS library, Boulder, Colo.

8. This view is elaborated in detail in the summary report by U.C.L.A., Appendix A. It appears in NCHEMS Technical Report 21, op. cit.

9. For a discussion of some of the problems associated with data comparability, see Ben Lawrence, et al, Data Comparability in Higher Education, NCHEMS monograph, (Boulder, Colo.: NCHEMS, September 15, 1971).

10. The details on equipment, data, and personnel requirements are discussed in NCHEMS Technical Report 20, op. cit., Chapt. 3.

11. R. J. Low, "An Administrator's Evaluation of RRPM-1," (unpublished paper dated June 14, 1971), p. 8.

12. NCHEMS Technical Report 20, op. cit.

13. NCHEMS Technical Report 21, op. cit.

14. NCHEMS Technical Report 20, op. cit., Sec. 7.2.

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